

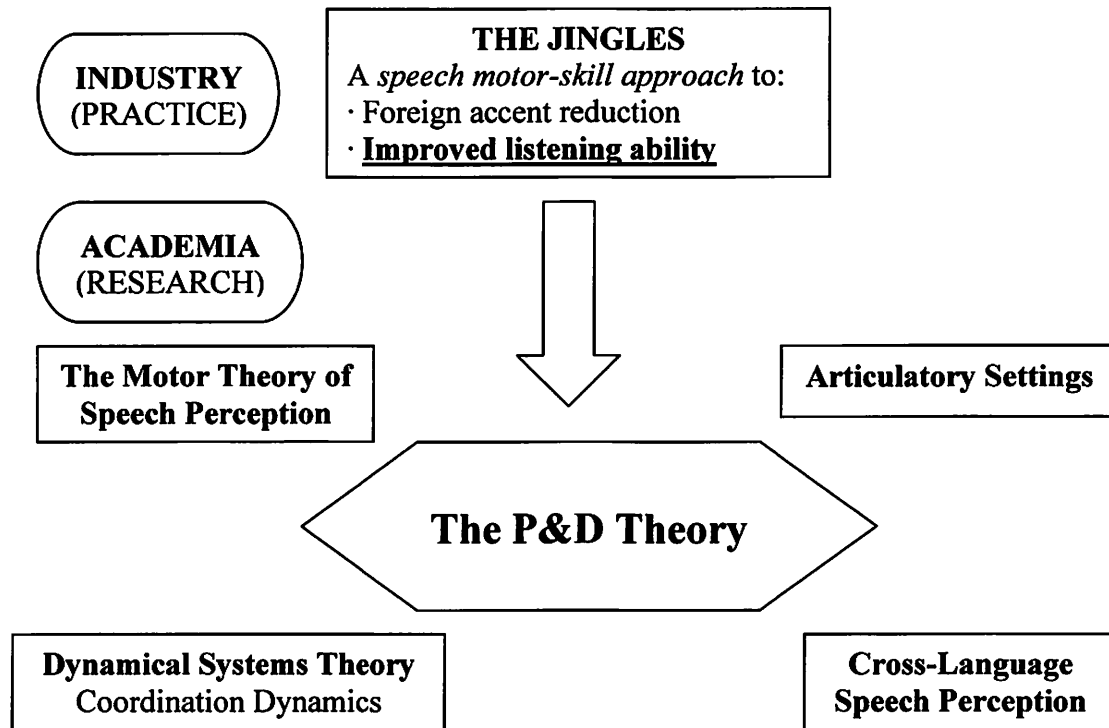
Walker's 'parity' fostering approach to speech perception in second language learning: a dynamical systems perspective

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Question: What would be the most effective training method to improve the perceptual ability in second language learning?

Hypothesis: A speech motor skill approach

OUTLINE



1. Background

- Perception research in L2 learning: focus has been on segments (e.g. Strange, 1995)
- However, speech is a continuous, parallel signal: coarticulation
- Walker's method specifically addresses the issue of coarticulation, and anecdotal comments suggest that the method is highly effective: however, empirical data is lacking

Aim: to provide a model that can synthesize the findings from the 'Two Cultures'

2. The Motor Theory of Speech Perception (Lieberman and Mattingly, 1985)

- The objects of speech perception are *the speaker's intended phonetic gestures*.

‘Perceptual objects are not acoustic: they are not articulator movements. They are, minimally, *gestures realized by coordinative structures*’ (Fowler & Rosenblum, 1989)

‘*Synergies and coordinative structures* connote the use of muscle groups in a behavioral situation. They are *functional grouping of muscles*.’ (Kelso et al., 1983)
- Speech gestures are represented in the brain as *motor control structures*.
- Speech perception recruits *speech motor system*.

3. THE JINGLES (Walker, 2001)

- Speech motor skill training program, by the use of ‘extra-hyper speech’.
- The aim is to establish appropriate synergies and the ability to coordinate gestures in a native-like manner, along the continuum of hyper- and hypo-speech.
- Acquire proper ‘*Articulatory Settings*’
→ the habitual articulatory configurations; set of motor habits (Jenner, 1987)
e.g. muscular tension, contact pressure

Walker’s assumptions on speech perception:

- (1) When L2 learners’ coordination of articulatory gestures is too disparate from that of native speakers, the L2 speakers have difficulty in listening comprehension as they cannot parse how native speakers coordinate their phonetic gestures.
- (2) L2 learners can improve listening ability by acquiring native-like speech motor skills, as it would allow the L2 learners to better parse phonetic gestures of native speakers.

4. Dynamical Systems Theory

- “The coordination dynamics express the organism’s *preferred and stable coordination tendencies* that exist at any moment.” (Zanone & Kelso, 1994)
- “Common coordination patterns” distinguish between skilled and less skilled performers (Temprado et al., 1997; Zanone & Kelso, 1992).
- An underlying coordination pattern is remarkably consistent within different skill groups (Bennet, 2003).

5. Cross-language speech perception

- Human newborns cannot discriminate between English and Dutch, German and Dutch, or Spanish and Italian (Sebastian-Galles & Kroll, 2003).
- “Non-natives without any knowledge of Germanic languages may fail to realize the between German and Dutch” (Sebastian-Galles, 2005)
- The difficulty in perceiving speech is dependent on both the language of speaker and the language of the listener: e.g. “for Spanish listeners, Italian and Greek natives are easier to understand than German and Spanish natives, when speaking English. But this is not the case for Dutch listeners.” (Sebastian-Galles, 2005)
- While native listeners find the native talker’s speech the most intelligible, non-native listeners find non-native talker from the same native language background equally or even more intelligible than native talkers. (Bent & Bradlow, 2003)
- L2 speakers use different acoustic parameters than L1 speakers (e.g. /l-r/ distinction by Japanese speakers, Underbakke et al., 1988). Cf. Native children change their perceptual strategy as their motor skills become more adult-like (“Developmental weighting shift (DWS)”: Nittrouer, 2002).

6. ‘Parity’ requirement in speech

- There must be sufficient equivalence, or ‘parity’, in the recognition of linguistic forms between the listener and the talker. (Lieberman & Whalen, 2000)

The Parity & Disparity Theory (P&D Theory): Hosomura, 2004

The listener’s ability to parse the speaker’s intended phonetic gesture, including the ability to decode the effect of coarticulation, depends primarily on the degree of similarity in the coordination dynamics between the speaker and the listener in performing given speech motor tasks.

- Perceptual ‘vernacular-ness’ and ‘foreign-ness’ in speech is defined along the continuum of ‘parity’ and ‘disparity’ in the phonetic gestures between the speaker and the listener, be it sociolinguistic accent or foreign accent.

Disparity Index (DI): the magnitude of disparity in the coordination dynamics between the speaker and the listener

Q. How can DI be measured?

A. Measured as *performance accuracy* (average coordination performance relative to goal) and *stability* of the motor performance in a given task space.

· THE JINGLES provides a way to reveal underlying coordination patterns (Walker, 2001).

The key is to “distinguish the *spontaneous coordination tendencies* from specific, momentary and local informational forces” (Zanone & Kelso, 1994).

<Example> in the ‘task-space’ of speaking English: DI is 0 for English speakers
Dutch speakers 1; German Speakers 2; Japanese speakers 6 (based upon Walker, 2001)

· The point is that it is possible to ‘quantify’ the degree of foreign accent, like ‘German speaker’s level’, ‘Dutch speakers’ level’, etc. For Japanese speakers, Walker sets their goal to achieve at least ‘Hindi-speaker’s level’. (Walker, 2001)

· **DI \approx NSR (Noise-to-Signal Ratio)**

Signal: *Phonetic Gestures* (i.e. speech signal)

Noise: what is processed as non-speech acoustic sequence, like Morse code

Q. Why do some L2 learners find ‘normal speed’ speech as ‘too fast to catch’?
Hypothesis. High NSR

· The most prominent perceptual problems in L2 speech learning, especially when L1 and L2 are linguistically distant, would arise from the ‘disparity’ in the speech motor skills between native speakers and L2 learners, as DI essentially translates into NSR.

Walker’s assumption: DI $\downarrow \approx$ NSR \downarrow

· The theory predicts that, for example, native speakers of Dutch can parse gestures of native speakers of Flemish, Afrikaans, German, English, significantly better than gestures of Vietnamese, Korean, and Japanese speakers, regardless of the languages these speakers produce.

Corollary: Because the task spaces of closer languages are inherently similar, once an appropriate motor skills are acquired for one language, DI and NRS for all the related languages will be automatically reduced.

· If Japanese speaker improve their speech motor skills to speak Dutch and the DI becomes smaller, then the DI’s, hence NSR’s, for all German, Flemish, Afrikaans, English and French will also be reduced. Similarly, English speakers would be able to reduce DI and NSR for Korean by acquiring native-like pronunciation of Japanese.

Observation: bilingual speakers of English and Japanese can pronounce Korean in with native-like pronunciation, whereas monolingual English speakers cannot.

7. Implications and future research goals

- Walker's work deserves further attention and efforts, as it offers powerful tools to studying the relation of speech production to speech perception.
e.g. Walker observes that introduction of new gestural combinations or movement patterns in the training process alters, sometimes adversely, previously stable coordination patterns (Walker, 2002). In the view of dynamical systems theory, motor strategies can be modeled in terms of attractor states, and "in finding new attractors provided by the system, the control landscape will change not just by adding new patterns but also by changing previously stable solutions" (van Lieshout, personal communication).
- Empirically test the predictions of the P&D Theory about L2(+) speech learning
e.g. When Japanese speakers improve their speech motor skills to speak English, their German pronunciation would also become more native-like (Walker, 2001). The P&D Theory predicts that their ability to perceive German will also improve.
- Obtain behavioral data: EMG, kinematics
- Compare subjects who have been trained with Walker's 'speech motor skill approach' and control subjects, both in their speech motor skills and perceptual ability
- Refine the concept of the DI, NSR, with rigorous quantitative approach: develop quantitative models using the tools of Dynamical Systems Theory

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